Economic Impacts of Renewable Energy and Energy Efficiency Policies in Michigan

Presented to:
House Energy and Technology Committee

May 23, 2007

www.nextenergy.org

Contents

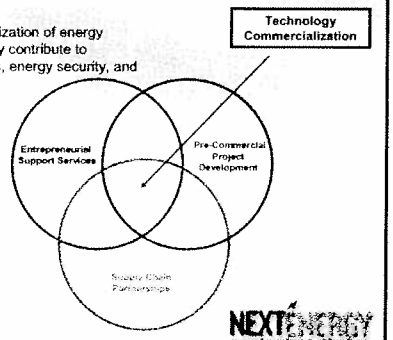
NextEnergy Overview

Mission:

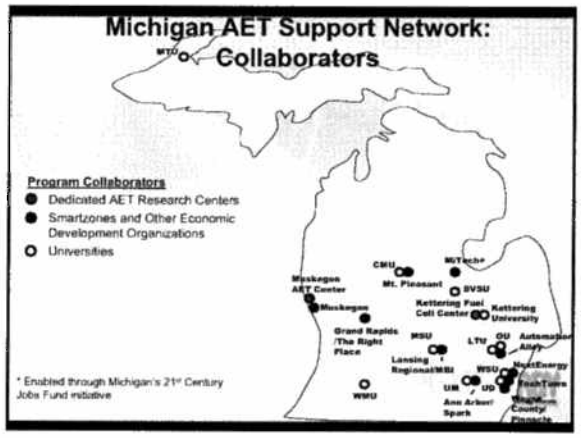
To enable the commercialization of energy technologies that positively contribute to economic competitiveness, energy security, and the environment.

NextEnergy Clients

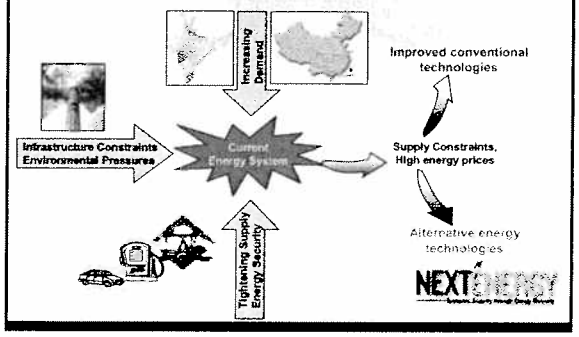
- Startup companies
- Early stage project developers
- [illegible]



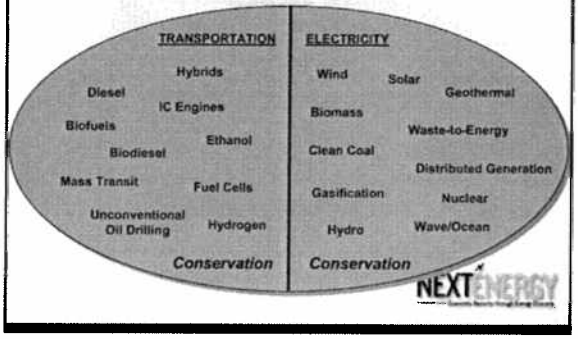
Michigan AET Support Network: Collaborators



A Diverse set of Market Pressures
A Diversity of Solutions



No single solution, no silver bullet ...



Alternative Energy: Significant Growth in Available Startup Capital

- $2.9 Billion in venture capital invested in "Cleantech" in North America during 2006
  - Fastest growing segment
  - Third largest segment
- Energy investments accounted for 74% ($2.1 Billion)
- 148 energy related transactions took place in 2006
  - Over 100% increase from 2003
- Hedge funds and most major banks aggressively entering space

Policy Requirements to be Competitive

Michigan has...

- Tax incentives
- Direct investment support in AET companies *
- Private equity investment capital *

Michigan needs more...

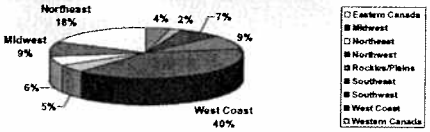
- **Market / demand stimulation**
  - Renewable Energy
  - Alternative Fuels

Why? ... Emerging technology development tends to cluster near the market

** Provided through 21st Century Jobs & Investment Funds, Venture MI fund*

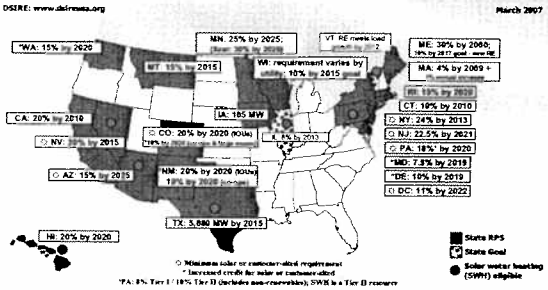
Investment is drawn to markets with alternative energy incentives (coasts)

2006 Cleantech Investment by Region



- California & New England receive almost 60% of cleantech venture capital
- The Midwest received only 9%

Investment Correlates Well with RPS



Energy Policy Drives Adoption Rates

- Need to level playing field with subsidies equal to those enjoyed by the fossil fuel and nuclear industries
- Recognize that societal benefits such as reduced pollution and national security are not reflected in energy market prices
- Recognize that benefits are difficult to capture since they are split among multiple constituents
- Recognize that increased use of local energy resources will lessen trade imbalance and multiply economic development
- To be a serious contender for jobs and economic growth, policies must be competitive

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Michigan's Electric Supply Needs are at a Crossroads

- **Michigan Needs New Electric Generation Capacity**
  - Michigan lacks sufficient generation to meet the electric load
  - 20 years since the last base load power plant was put in operation
  - Highly dependant on imported electricity to ensure electric reliability
  - Will need to build 3,440 MW of new generation Capacity by 2015 under current regulation
- **Michigan Lacks Any Energy Efficiency Programs**
  - Most Energy Efficiency Programs and Demand Side Management programs ended in the early 90's
  - Energy Efficiency programs could reduce the need for two base load fossil fuel plants by 2015 – 21st CEP

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Michigan's Electric Supply Needs are at a Crossroads (Continued)

- **Michigan is Behind 22 Other States in Enacting Renewable Portfolio Standards**
  - If Michigan wants to be viewed as a serious contender for alternative energy jobs, this issue must be dealt with

What are the true impacts on Michigan's economy of implementing policy's that promote Energy Efficiency and Renewable portfolio Standards?

This study provides fact-based answers to this question.

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Project Team

- **Funding Sources:**
  - Michigan Public Service Commission
  - Herbert H. & Grace A. Dow Foundation
- **Project Sponsor / Oversight:**
  - Michigan Department of Environmental Quality
- **Project Management:**
  - NextEnergy
- **Modeling Team:**
  - Systematic Solutions, Inc. – ENERGY 2020
  - University of Michigan – Regional Economic Models, Inc. (REMI)
- **Primary Report Author:**
  - Richard A Polich, Energy Options & Solutions

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Modeling Tools

- **ENERGY 2020**
  - Used to model Michigan's electric load and supply options
  - Generates forecasted load
  - Selects the best economic supply alternatives
  - Produces a projection of generation capacity requirements, fuel consumption, emissions and electric costs
  - Generally consistent with modeling assumptions and results underlying 21st Century Energy Plan
- **Regional Economic Models, Inc. (REMI)**
  - Used to model the economic impacts on Michigan of energy policy changes
  - Generates year-by-year estimates of the regional economic effects of policy initiatives
  - Produces key economic metrics, including Gross Regional Product (GRP), employment levels ,and Disposable Personal Income

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Cases Modeled

- **Base Case – No Energy Efficiency program; no new renewables**
- **Low Energy Efficiency – 443 GWh/yr reduction; cost of $55.81/MWh**
- **Moderate Energy Efficiency – 755 GWh/year; cost of $27.74/MWh**
- **Low RPS – 7% by 2016, flat thereafter**
- **Moderate RPS – 15% by 2025 (resulting in 11% by 2020)**
- **Low EE and RPS – combined low cases**
- **Moderate EE and RPS – combined moderate cases**
- **Low RPS with Michigan Manufacturing – Low RPS with 100% wind content derived from MI sources**
- **Moderate RPS with Michigan Manufacturing – Moderate RPS with 100% wind content derived from MI sources**

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Data Sources

- **21st CEP Capacity Needs Forum**
  - Energy Prices
  - New Generation Capacity Capital Costs
  - Operation and Fuel Costs
  - Electric Load Forecast
- **21st CEP Energy Efficiency & Load Management Workgroup**
  - Energy Efficiency Impacts on Electric Load
  - Energy Efficiency Program Costs
- **21st CEP Renewables Work Group**
  - RPS Capital and operating costs
- **REMI Policy Insights**
  - Michigan Economic Data

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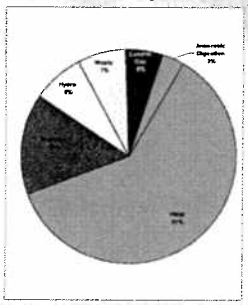
Renewable Installed Capacity and Energy Generated in 2025 (15% RPS in 2025)



	2025	
% Renewable Energy		15%
	GWh	MW
Wind	13,176	5,380
Biomass	3,282	486
Hydro	1,702	311
Waste	1,573	274
Landfill Gas	1,225	155
Anaerobic Digestion	684	99
TOTAL	21,631	6,864

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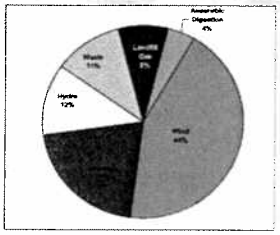
Renewable Installed Capacity and Energy Generated in 2020 (15% RPS in 2025)



	2020	
% Renewable Energy		11%
	GWh	MW
Wind	5,126	2,492
Biomass	2,938	419
Hydro	1,702	311
Waste	1,573	274
Landfill Gas	1,122	142
Anaerobic Digestion	625	89
TOTAL	14,085	3,727

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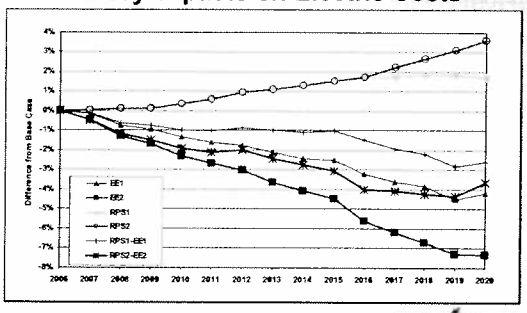
Summary Economic Impacts: EE and RPS (Incremental Changes 2007-2020)

RPS Assumptions: 15% by 2025 (11% by 2020)

	Min. Wind Manuf.* (with EE)	Max. Wind Manuf. ** (w/o EE)
Gross Reg. Product (NPV $Millions)	+$1,100	+1,600
Total Increased Employment Over Period:	+17,000	+19,000
Assumptions		
Energy Efficiency (reflects 21st CEP):		
Avg. Annual Energy Reduction (2007-25)	750 GWh	N/A
Peak electric demand reduction (2025)	2,800 MW	N/A
Average EE Resource Cost	$27.74/MWh	N/A
Renewable Energy:		
RE Installed Capacity (2025)	6,700 MW	6,700 MW
RE Energy Generated (2025)	21,600 GWh	21,600 GWh

* Assumes EE policy consistent with 21st CEP & RPS with minimal manufacturing of renewable components (8%) in MI.
** Assumes no EE policy and RPS with maximum manufacturing of renewable components (100%) in Michigan.

Policy Impacts on Electric Costs



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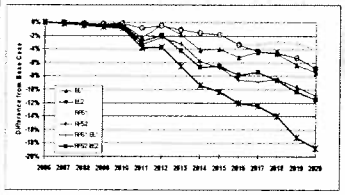
CO_2 Emissions



	Total CO2 Reduction from Base Case 2007 thru 2030		Value of CO2 at Today's Market Price
	millions of Metric Tons	Reduction	($millions)
EE1	36.461	3.0%	$152.56
EE2	60.586	5.0%	$254.12
RPS1	20.448	1.7%	$85.88
RPS2	27.578	2.3%	$115.83
EE1-RPS1	60.406	5.0%	$253.71
EE2-RPS2	96.294	8.0%	$404.43

- CO_2 Emissions highest for Base Case
- **Moderate Energy Efficiency program could reduce CO_2 emissions by 10,900 million metric tons/yr by 2020**
- **Moderate RPS could reduce CO_2 Emissions by 6,500 million metric tons/year by 2020**
- **Combined Moderate Energy Efficiency and RPS could reduce year 2020 CO_2 emission by over 17,800 million metric tons/year**

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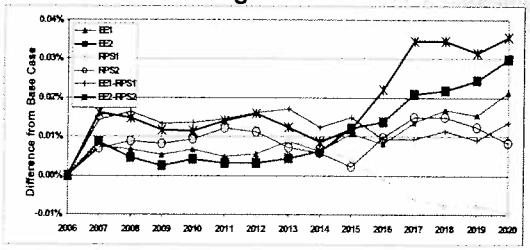
Gross Regional Product



Increased GRP: (2007-2020)

- Energy Efficiency - $553 Million to $637 Million
- RPS - $194 to $553 million
- Combined EE & RPS - $750 million to $1.1 billion
- RPS with Renewable Manufacturing - $455 to $1.6 Billion

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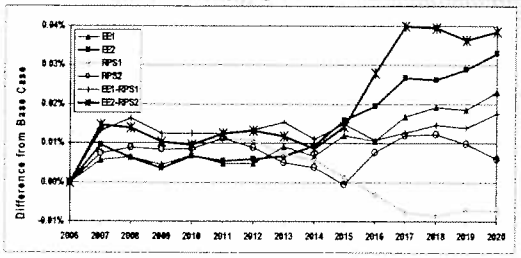
Employment



Increased Employment: (2007-2020)

- Energy Efficiency – 8,783 to 12,057 cumulative jobs
- RPS – 2,020 to 6,381 cumulative jobs
- Combined EE & RPS – 11,204 and 17,191 cumulative jobs
- RPS with Renewable Manufacturing – 5,029 and 19,005 cumulative jobs

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Conclusions

- Implementation of energy efficiency programs at the levels included in the 21st CEP will result in significant economic benefit to Michigan over the Base Case
- Economic impacts (GRP and employment) from an RPS are positive over the life cycle of renewable power generation plants (versus fossil generation plants)
- A combined Energy Efficiency and RPS will defer the need for new coal generation and its associated emissions and environmental impact
- Actual economic impacts are likely to be greater than reflected in the report, due to significant increases in pulverized coal costs from 21st CEP
  - Consumers Energy IRP forecasts $1,934/kW vs. $1,480/kw in 21 CEP

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Conclusions (Continued)

- If a state or national RPS were to be put in place, Michigan could gain considerably relative to other states since it is a superior location for wind resources, manufacturing job potential and investment [1]
- Emission reductions (esp. carbon dioxide) illustrated in all the cases studied are significant and could have significant value to Michigan's residents, above that reflected in the calculations of GRP, employment [2].

[1] "Component Manufacturing: Michigan's Future in the Renewable Energy Industry", Renewable Energy Policy Project, November 2006.

[2] "Michigan at a Climate Crossroads", University of Michigan Center for Sustainable Systems, April 2007 (Report No. CSS07-02)

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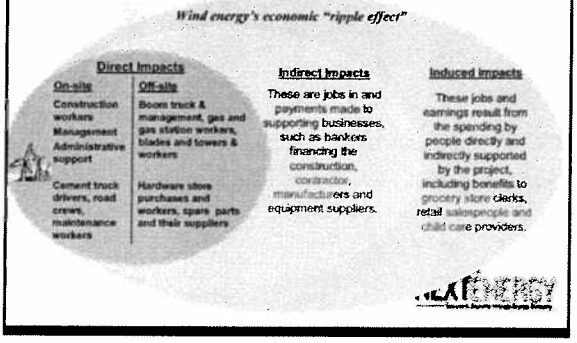
Where are the Renewable Energy Jobs? Example: Wind Energy

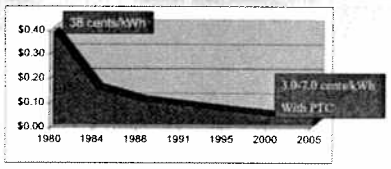


US Wind Energy Installed Capacity

- 1980 10MW
- 1985 1,039MW
- 1990 1,525MW
- 1995 1,697MW
- 2000 2,578MW
- 2005 9,149MW

- Source: www.awea.org

Reduced Cost Driving Wind's Success

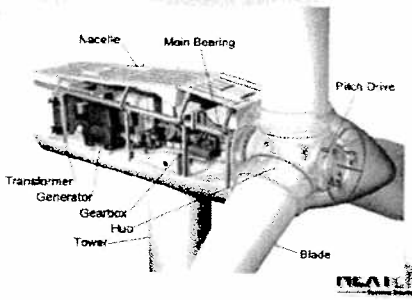


Cost of wind energy at excellent wind sites

Current Wind Component Manufacturing in Michigan

- Approx. 35 companies currently supply design, engineering, and manufacturing services to the wind industry.
- Over 100 manufacturers have joined the NextEnergy led Michigan Wind Energy Manufacturing Working Group
- Ranked 4th in the nation for companies rated best equipped to manufacture wind power components

Wind Components



Michigan Based Wind Energy Manufacturers

- Cobasys - Batteries
- Kaydon Corporation - Bearings
- ADCO Circuits - Controls
- Siemens VDO Electric Drives - Controls
- Williams Form Engineering Corporation - Fasteners
- Nord-Lock - Fasteners
- Ann Arbor Machine Company - Gear and Gear Boxes
- Gear Technologies - Gear and Gear Boxes
- Great Lakes Gear Technologies, Inc. - Gear and Gear Boxes
- NSK Corporation - Gear and Gear Boxes
- Danotak Motion Technology - Generators
- Merrill Fabricators - Generators
- Diversified Sales and Service, Inc. - Installers
- Freedom Power - Installers
- American Chemical Technologies
- Axson North America - Lubricants/Chemicals
- Simrit, Division of Freudenberg-NOK - Lubricants/Chemicals
- Kurdziel - Machined, Cast, and Forged Components
- Citation Corporation - Machined, Cast, and Forged Components
- Steel Industries, Inc. - Machined, Cast, and Forged Components
- Three M Tool & Machinery - Gear Boxes and Machined Components
- K&M Machine Fabricating, Inc. - Machined, Cast, and Forged Components
- Tool North, Inc. - Machined, Cast, and Forged Components
- Su-Dan Corporation - Machined, Cast, and Forged Components
- Trenton Forging - Machined, Cast, and Forged Components
- Triad Services Group - Machined, Cast, and Forged Components
- Wahoo Composites - Machined, Cast, and Forged Components
- Arcturus Energy Systems – System Integrators
- Ricardo Engineering – System Integrators
- Pernetic Generator Group - Technology Developers
- Wind to Energy - Technology Developers
- How-Aire – Rotor and blade fabrication
- Moran Iron Works - Tower construction

Manufacturing Potential to Serve U.S. Growth in Renewables (Total U.S.)*

Total U.S.	# U. S. MW	Number of Firms	Millions $ Investment	New FTE Jobs
Wind	124,900	16,480	$62,338	398,470
Solar	23,150	10,272	$69,624	298,194
Geothermal	15,190	3,926	$15,330	72,324
Biomass	21,760	12,020	$13,248	81,615
Total:	185,000	42,698	$160,541	850,603

* Assumes 18,500 installed per year for 10 years in U.S.
("Climate Stabilization Case", REPP, 11/06)

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Manufacturing Potential to Serve U.S. Growth in Renewables (Michigan)*

Michigan	# U. S. MW	Number of Firms	Millions $ Investment	New FTE Jobs
Wind	124,900	967	$3,453	24,350
Solar	23,150	360	$1,256	6,644
Geothermal	15,190	129	$272	1,502
Biomass	21,760	594	$349	2,281
Total:	185,000	2,050	$5,328	34,777

* Assumes 18,500 installed per year for 10 years in U.S.
("Climate Stabilization Case", REPP, 11/06)

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Incremental Investment and Job Potential by County – Top 10

	New Investment (millions)	Jobs
Wayne	$557	3,431
Kent	$514	3,575
Oakland	$480	3,063
Macomb	$465	3,227
Grand	$439	2,999
Monroe	$396	1,693
Saginaw	$180	1,197
Muskegon	$176	1,195
Berrien	$139	923
Ottawa	$130	966

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Question for Legislature: Will Michigan Lead or Follow?

In 1999, the Texas Legislature:
- Creates competitive electric market
- Sets renewable portfolio standard (RPS)

About 180 MW of wind installed (by Dec.)

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7 Years Later: 2006

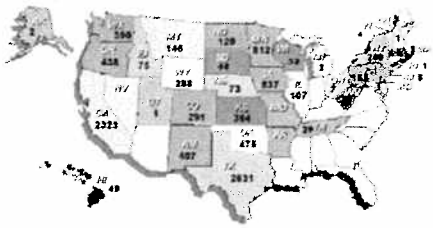
Texas passes California to become #1 in installed wind capacity

2,768 MW installed

Wind Leaders

- Germany
- Spain
- USA
- India
- Denmark
- Texas
- China
- California
- Italy
- United Kingdom
- Portugal

Wind Energy Projects in the US



Bold Action in Texas → Verifiable Economic Development Benefits

(2002 Estimated Statistics)

- Installed Capacity = 1,103 MW in 2002 (2,768 MW in 2006)
- Number of Texas Counties with Wind Projects = 10
- Taxable Value of Wind Power Plants = $777 million
- Property tax payments to local school districts = $11.6 million in 2002
- Landowner Royalty Income = $2.5 million in 2002
- Wind-related jobs (direct) = 2,500

Michigan: Fix the Past or Create the Future?

- Michigan's History
  Fur Trade → Timber → Auto Manufacturing → ??
- Is Alternative Energy (or more broadly, "Cleantech") our economic destiny?
- If so, its time to position Michigan to lead!
  - Requires bold policy action … RPS and beyond

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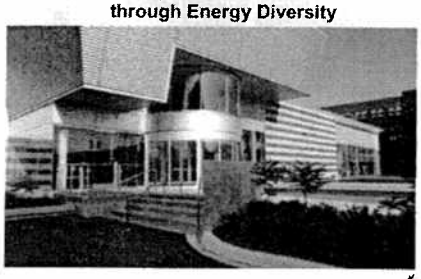
Economic Security through Energy Diversity

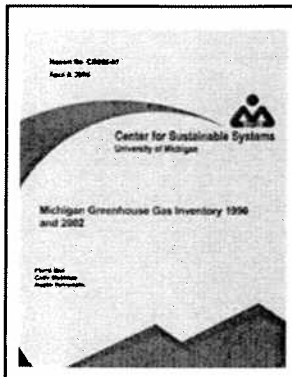


Michigan at a Climate Crossroads: Strategies for Guiding the State in a Carbon Constrained World

Gregory A. Keoleian, Ph.D
Associate Professor of Sustainable Systems,
School of Natural Resources and Environment
Co-Director, Center for Sustainable Systems
University of Michigan

House Energy and Technology Committee Meeting

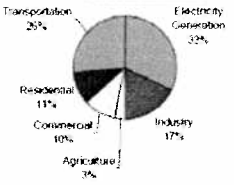
May 23, 2007



Michigan was the 41st state to conduct their greenhouse gas Inventory.

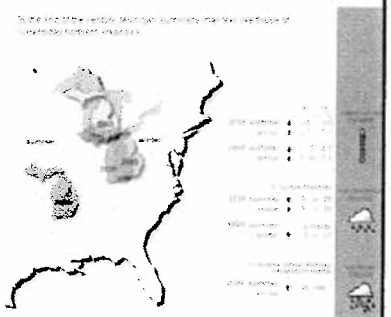
Michigan Emissions Sector Breakdown

IPCC Category	Emissions (MMTCE) 1990	Emissions (MMTCE) 2002	Percent Change (1990 to 2002)	Percent of Total Emissions 1990	Percent of Total Emissions 2002
Energy	50.16	54.25	8.2%	87.4%	86.7%
Industrial Processes	1.79	3.06	70.9%	1.6%	2.5%
Agriculture	1.92	1.87	-2.7%	2.0%	1.6%
Waste	3.55	3.40	-4.2%	6.6%	5.8%
Total	57.42	62.59	9.0%	100%	100%



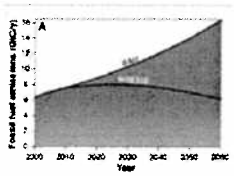
Sector Breakdown for 2002 Greenhouse Gas Emissions

Projected Climate Change for MI



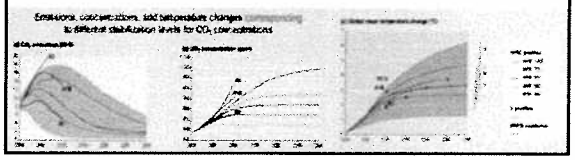
Kling, George et. al. **"Confronting Climate Change in the Great Lakes Region"** (2003) UCS.
http://www.ucsusa.org/greatlakes/glimpactmigrating.html

Critical Challenge: Stabilize CO_2

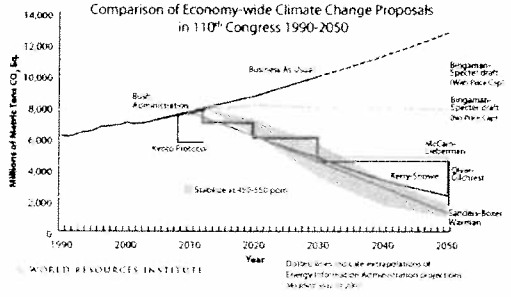


Stabilizing the atmospheric concentration CO2 at 450 ppm will even have significant ecological, social and economic impacts.

Pacala and Socolow 2004



Comparison of Economy-wide Climate Change Proposals in 110th Congress 1990-2050



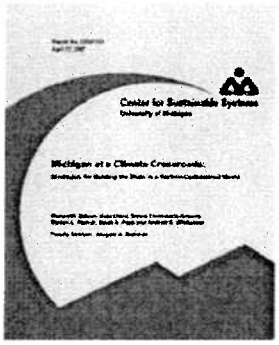
Embargoed until 10 a.m. May 8, 2007

Contact: John Eales
Office: 202-585-2077
Mobile: 202-285-1706

MAJOR BUSINESSES AND ENVIRONMENTAL ORGANIZATIONS JOIN CALL TO ENACT NATIONAL CLIMATE CHANGE LEGISLATION

U.S. Climate Action Partnership Announces 14 New Members

WASHINGTON, D.C., May 8 – The United States Climate Action Partnership (USCAP) announced today that it has doubled its membership to include new members American International Group (AIG), Alcan, Boston Scientific, ConocoPhillips, Deere & Company, The Dow Chemical Company, General Motors Corp., Johnson & Johnson, Marsh, Pepsi Co, Shell and Siemens, along with The Nature Conservancy and the National Wildlife Federation



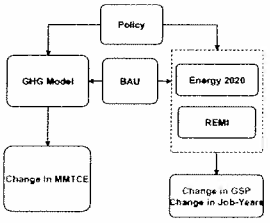
Purpose: To determine the ***greenhouse gas emissions reduction potential*** of state policies and the effect of the policies on the state economy in terms of ***gross state product and jobs***.

Process: Multistakeholder collaborative (150+ participants including automotive, energy, ag, mfg., govt., NGO sectors); two Forums at U. Michigan.

Strategies and Modeling Approach

Mitigation Strategies and Policies

Renewable Portfolio Standard
Renewable Energy Production Tax Credit
Appliance Efficiency Standards
Carbon Sequestration on Marginal Agricultural Lands
Renewable Fuel Standard
Ethanol Production Tax Credit
Alternative Vehicle Technology Tax Credit
Combined Heat and Power Tax Incentive
Mandatory Residential Energy Codes
Mass Transportation Fuel Switching



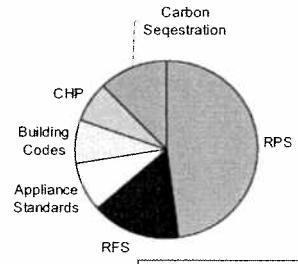
MMTCE = Million Metric Tons Carbon Equivalent
GSP = Gross State Product
Job-Years = Average increase in employment over a baseline on a year-by-year basis. For example, 100 job years is equivalent to either 10 jobs lasting 10 years or 100 jobs lasting one year.

GHG and Economic Results Best Case Scenario by 2025

Policy	Cumulative GHG Savings (MMTCE)	Avg. Annual GSP (2000 $Millions)	Avg. Annual Jobs-Years
RPS – 20% by 2025	39.9	64.6	881
RFS –Cellulose and Corn Based Ethanol Supply (25% by 2025)	13.2	283	1,700
Carbon Sequestration – 10% magland planted, no state cost-share	10.3	-46.7	-212
Appliance Standards – SB 1333 of 2006	7.35	38.3	437
Building Codes – IECC 2006 and DOE Insulation recommendations	6.83	54	644
Combined Heat and Power – 180MW, 6,570 hr/ yr ($0.05/ kWh state subsidy)	6.09	-13.6	-81

MCCP GHG Results

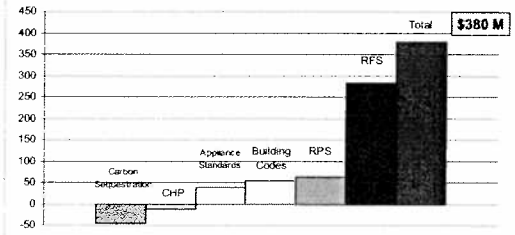
Cumulative GHG Emission Reductions (MMTCE) from Integrated MCCP Policy Scenarios (2007 - 2025)



84 MMTCE GHG Emissions Reductions

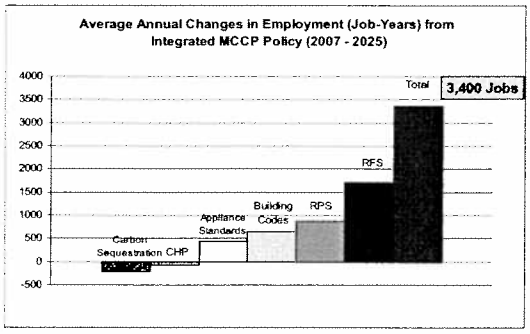
MCCP Economic Results

Average Annual Changes in Gross State Product (2000 $Millions) from Integrated MCCP Policies (2007 - 2025)



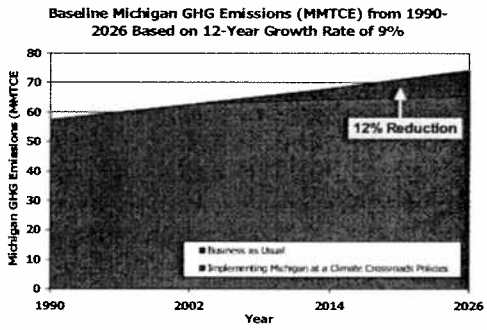
Sequestration (afforestation) and CHP have neg. impacts due to a state subsidy policy
Michigan Business as Usual GSP: 2007 - $407.8 B 2025 - $595.4 B

MCCP Economic Results



Sequestration (afforestation) and CHP have neg. impacts due to a state subsidy policy
Michigan Business as Usual Job-Years: 2007 – 5,670,000 2025 – 6,030,000

Michigan Greenhouse Gas Emissions Outlook



Conclusions

- Policies lead to GHG reductions and have a positive impact on the state's economy in terms of jobs and GSP
  - RPS provides the greatest GHG reduction
  - Sequestration (Afforestation) and CHP are the only strategies with a negative economic impact due to the state subsidy policy
- Policies mitigate projected state GHG emission growth
  - Reduce economic risks
  - Help the state prepare for likely federal action
  - More substantial actions are needed
- Greater economic benefits expected
  - Economic modeling did not take into account carbon credits.
    - The Chicago Climate Exchange has operated a voluntary carbon-trading market since 2003, in which carbon prices range from $3.67 -$18.33/MTCE. Under this price scenario, the cumulative MCCP GHG emission reductions (84 MMTCE) would be roughly valued between $308 million and $1.54 billion by trading the carbon offsets that these policies produce.
    - The US Department of Energy's Energy Information Administration analyzed proposed bills and predicted future (2025-2030) carbon prices ranging from $52-$180/MTCE.
  - Manufacturing wind turbines in Michigan would generate additional benefits

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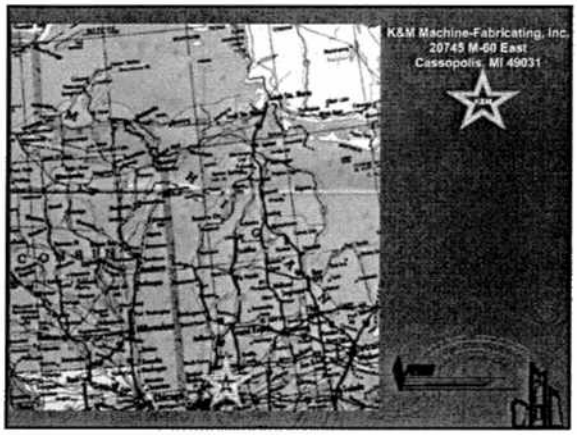
NATURAL RESOURCES AND ENVIRONMENT
UNIVERSITY OF MICHIGAN

K&M Machine Fabricating Inc.

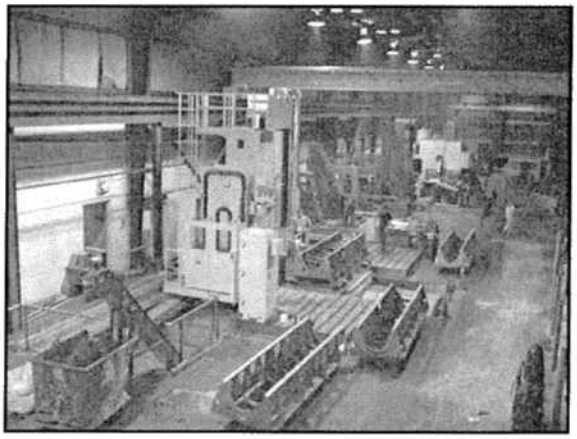


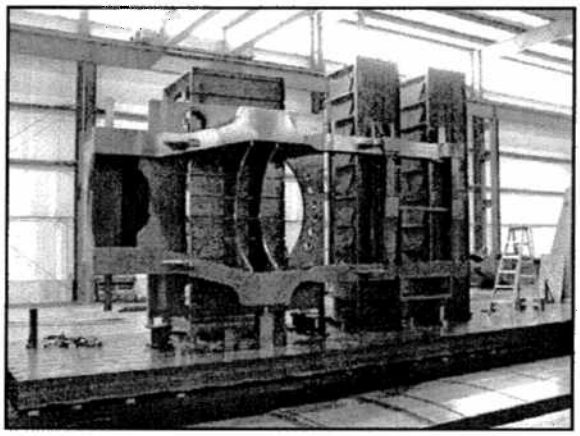
K&M Machine-Fabricating, Inc.

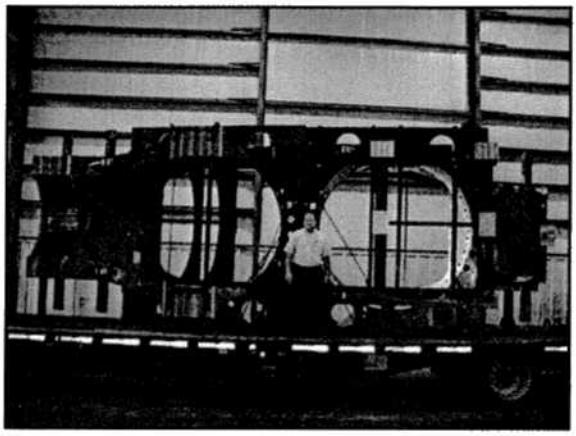
- Founded 1951
- Over 210 Employees
- 3 Manufacturing Facilities, one site
- 281,000+ Square Feet

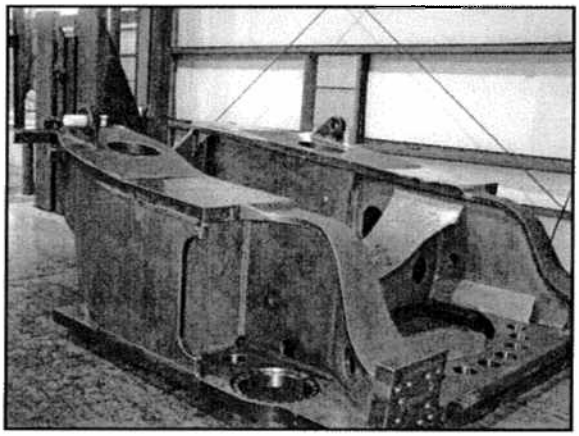
K&M Machine-Fabricating, Inc.

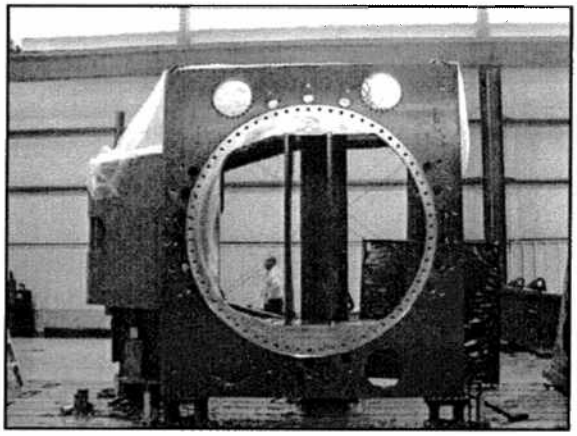
K & M Machine - Fabricating, Inc. Consists of a 3 Building Complex Located on 92 Acres. K & M is a Full Service, One Stop Shop, Contract Manufacturing Company Producing Parts to Our Customers' Specifications.

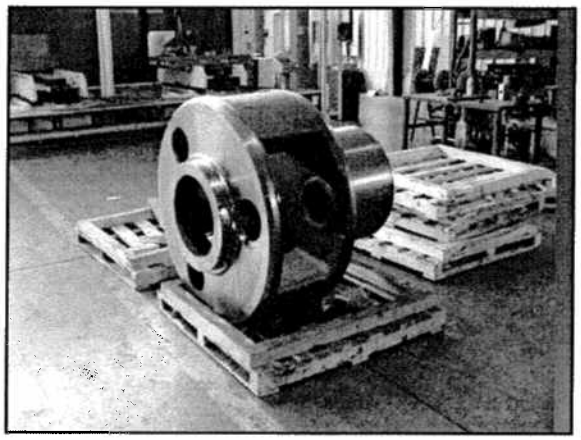


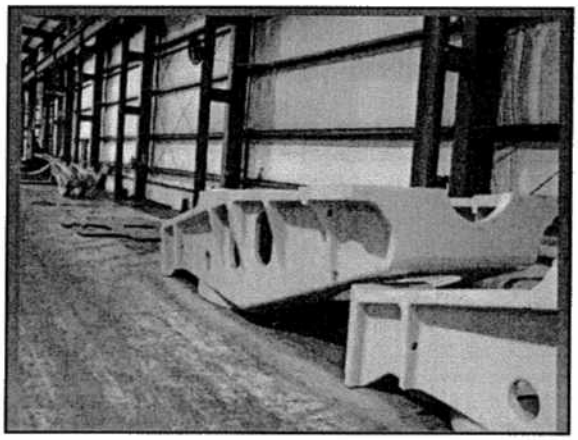


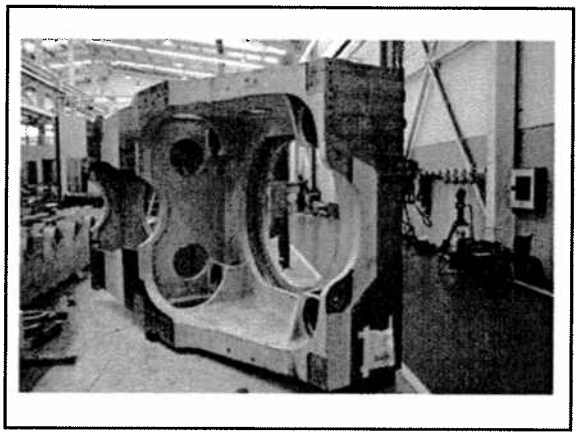


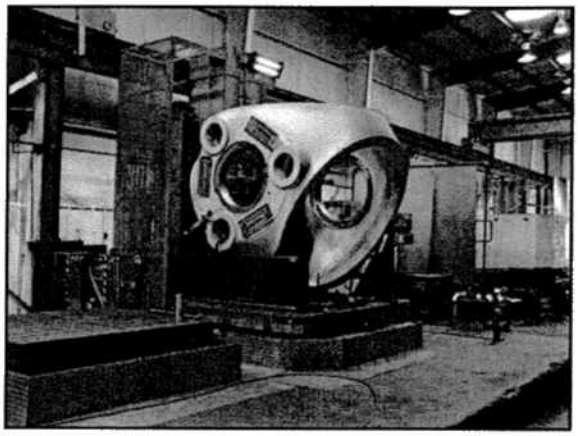


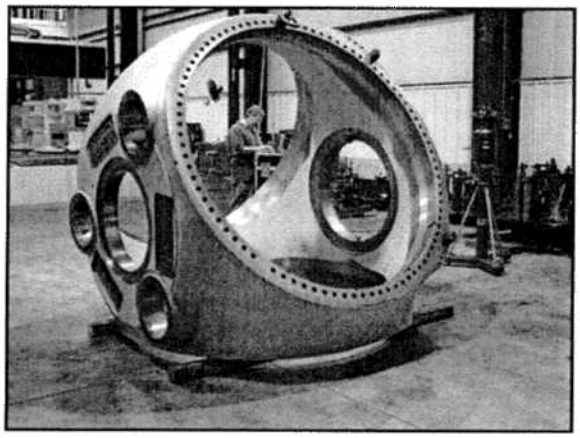


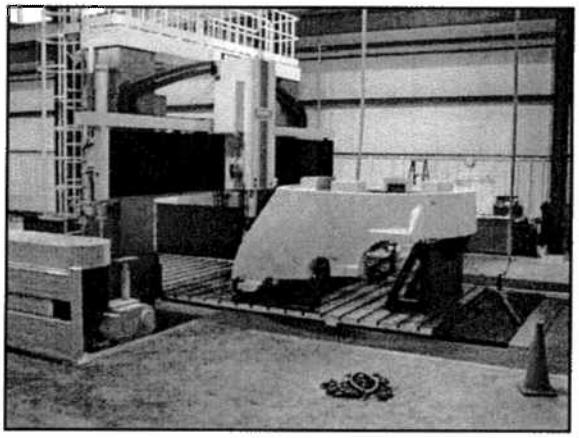


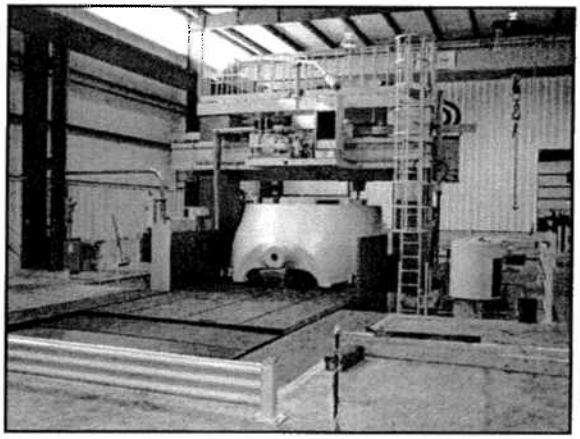


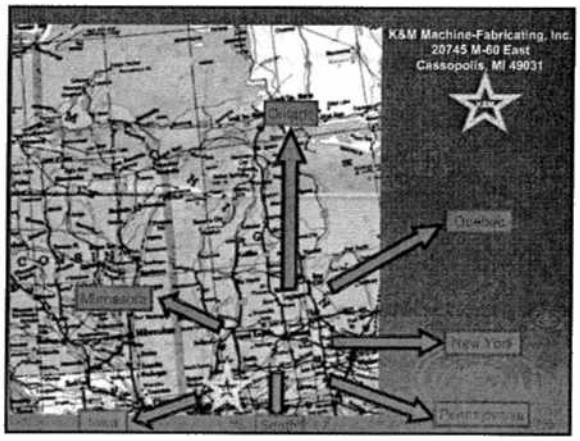








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